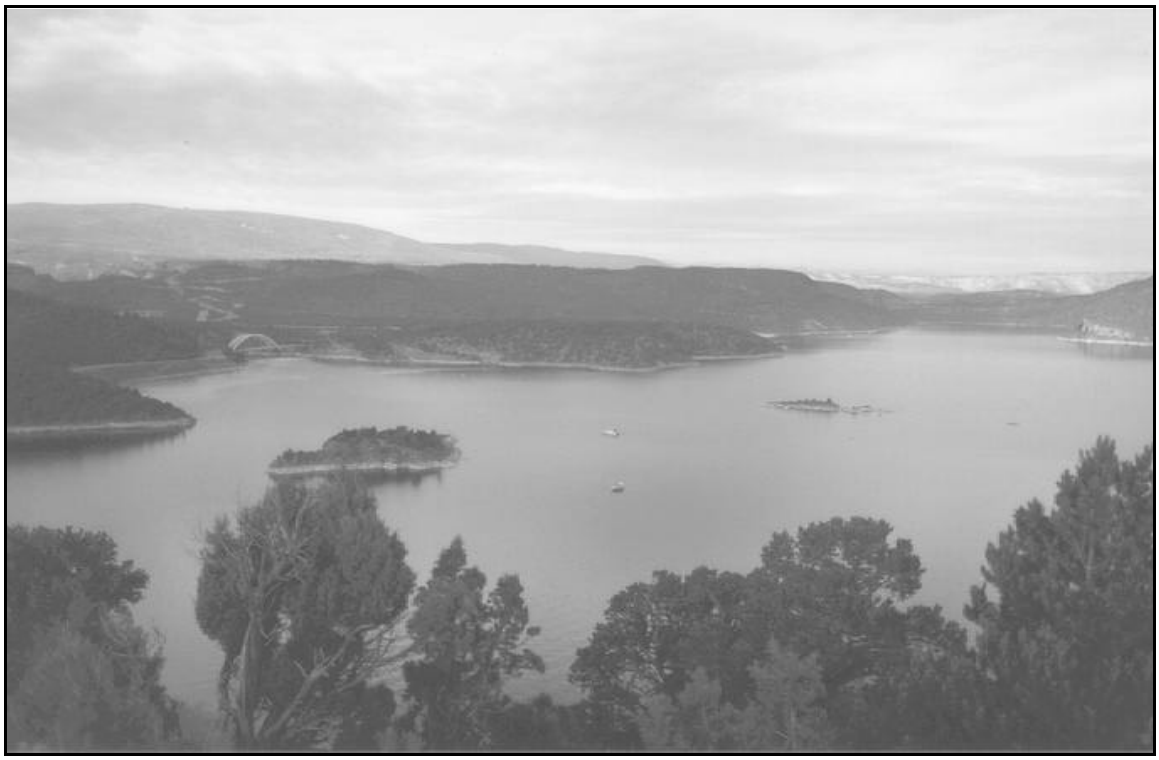
FLAMING GORGE RESERVOIR



Introduction

Flaming Gorge Reservoir is one of the largest bodies of water in Utah. It was built to impound spring floods in the Green River and store them for year-round use for Arizona, Nevada, and southern California. The reservoir is second only to Lake Powell in size and recreational popularity. This reservoir holds the state record for several species of trout. The lower end of the reservoir is in Red Canyon and the Flaming Gorge itself, while the upper part spills over the Wyoming deserts. Flaming Gorge and Red Canyon are both several thousand feet deep and with brick-red walls. They were named by John Wesley Powell, the leader of the first intensive exploration of the Green/Colorado Rivers. The dam was built in Red Canyon, the second of five deep canyons the Green River has carved through the Uinta Mountains. A lake, rather than a river, now lies at the bottom of the gorge. Millions of years ago, drainage in the area was to

Characteristics and Morphometry

Lake elevation (meters / feet)	1,836 / 6,023
Surface area (hectares / acres)	17,000 / 42,020
Watershed area (hectares / acres)	5,013,765 / 12,384,000
Volume (m^3 / acre-feet)	
capacity	4,673,740,000 / 3,789,000
conservation pool	
Annual inflow (m^3 / acre-feet)	
Retention time (years)	2.3
Drawdown (m^3 / acre-feet)	
Depth (meters / feet)	
maximum	133 / 436
mean	64.5 / 212
Length (km / miles)	68.56 / 42.6
Width (km / miles)	.580 / .3
Shoreline (km / miles)	335 / 208

Location

County	Daggett, UT and Uintah, WY
Longitude / Latitude	109 34 11 / 40 58 42
USGS Map	Flaming Gorge, UT 1966
DeLorme's Utah Atlas & Gazetteer™	Page 56, A-3
Cataloging Unit	Upper Green River/Flaming Gorge Res.(14040106)

the east into the Platte River drainage. During the Pliocene, central Wyoming was uplifted and the headwaters of the Green River captured the drainage. Subsequent uplift has taken place in the Uinta Mountains area, and the Green River has essentially maintained its original elevation, carving deep canyons through the mountains.

Damming rivers is easiest in narrow canyons. Dams have been proposed in Lodore, Whirlpool and Split Mountain Canyons, but the dam in Red Canyon is the only one that has ever been built.

Construction was begun in 1958 and completed in 1964. The 502 foot high dam was built out of concrete in an arch shape. Land surrounding the reservoir is managed by the Flaming Gorge National Recreation Area. Public access is unrestricted. Water is used for both culinary and irrigation purposes.

Recreation

Accesses to Flaming Gorge National Recreation Area are on US-191 between Green River, WY and Vernal, UT. Access from the north and west is also possible on Wyoming Highway 414, from I-80 at Fort Bridger, WY to Manilla, UT. Recreational areas are concentrated along the south side of the Flaming Gorge and Red Canyon on U-44, which connects US-191 to W-414. Access areas are well marked.

Cross-country skiing, fishing, boating, swimming, camping, picnicking, cliff diving, and water skiing are all popular. Although most recreation areas are closed in the winter, there is still opportunity for wintertime activities. Boat ramps are available at Sheep Creek Bay near Manilla and at sites near the dam. There are dozens of campgrounds in the recreation area. For further recreational information, contact the Recreation Area Headquarters (see info box). There is a private campground in Manilla.

There are visitors centers at the dam and on the south shore of the reservoir. Interpretive exhibits, recreational information, and tours of the 50 story tall dam and hydroelectric turbines are available.

Watershed Description

Flaming Gorge Reservoir is located on the Green River as it cuts through the Uintas. The immediate area consists of steep canyon walls and high mountains, with heavy precipitation in the Uintas. Clear mountain streams flow into the south shore of the reservoir, fed by melting winter snowpack. The area is heavily forested, and logging takes place.

In the transition area between the Uintas and the Wyoming desert, the rock strata are sharply tilted to the south, and vegetation communities gradually taper from dense forest to sagebrush. The various strata in close proximity result in variable topography, with steep escarpments, deep canyons, and undulating softer layers. The Sheep Creek Natural Area, west of Flaming Gorge, has a paved road traversing many different strata.

The Wyoming deserts are barren and receive little precipitation. The Green River flows south across them for several hundred miles, from the Wind River Range to the Utah state line.

The source of the Green River is in the Wind River Mountains, the highest range in Wyoming and one of the most remote ranges in the continental United States. The watershed high point, Gannett Peak, is 4,201 m (13,785 ft) above sea level, thereby developing a complex slope of 1.2% to the reservoir. Slopes to the south of the reservoir, however, average 15% to the ridgeline of the Uintas at 10,000'. The average stream gradient of the Green River above the reservoir is 1.2% (64 feet per mile) The major inflows are the Green River, Blacks Fork, and Henrys Fork. Minor inflows include Carter Creek, Sage Creek, Spring Creek, Summers Dry Creek, Currant Creek, Cart Creek, and Birch Spring Draw. There are numerous natural lakes in the Uintas and the Wind Rivers. Many streams have been impounded or diverted for irrigational purposes. Major upstream reservoirs include Fontanelle Dam and Big Sandy Reservoir.

The watershed is made up primarily of high mountains, foothills, high desert plains, and badlands. The soil associations that compose the watershed are listed in Appendix III.

The vegetation communities, in order from desert to alpine, include barren areas, grass-sagebrush, agricultural land, giving way to pinyon-juniper, oak, maple, mountain mahogany, which in turn give way to pine, aspen and fir, and finally to alpine. The watershed receives 20 - >102 cm (8 - >40 inches) of precipitation annually. The frost-free season around the reservoir is 80 - 120 days per year.

Land use in the watershed is primarily open range in

the high deserts, and multiple use in the mountains. The thick forests on the north slope of the Uintas are intensively logged, including areas less than one mile from the reservoir. Much of both the Uinta and Wind River portions of the watershed are federally protected wilderness areas.

Limnological Assessment

In general, Flaming Gorge Reservoir was found to be of good water quality. The water quality varies in the reservoir because of its exceptional length (69 miles) and variable depth (9-133 meters). In the northern arms of the reservoir eutrophic conditions prevail characterized by silty water, macrophyte growth, algal blooms, depressed dissolved oxygen with depth and higher concentrations of nutrients. These types of conditions lead to higher production and reduced transparency. As one moves downstream towards the dam eutrophic conditions tend to improve. Production tends to fall and water clarity improves. This is a typical type of transition for reservoir as large as Flaming Gorge. As sediments and nutrients drop out of the water column the nutrient base is not available for primary production. It is not uncommon to find embayments along the reservoir with higher states of production as sources of nutrients move into the reservoir through various types of sources.

To understand the limnology of the reservoir, historically it has been divided into three zones: (1) riverine, (2) transition, and (3) lacustrine. The riverine zone is described as that area from inflow to Buckboard Marina. It is considered to be the most productive area of the reservoir with nuisance blue-green algae blooms. Although fish kills may occur due to the toxin formed when these blue-green algal (primarily *Aphanazominon* and *Anabaena*) blooms breakdown, they are more likely to result due to the decreased dissolved oxygen content in the water column present in the later part of the summer season under stratified conditions. Another problem that has been documented is the elevated temperatures in the epilimnion late in the summer which forces cold water species down in the water column. Thus fishery habitat area is reduced by low dissolved oxygen in the hypolimnion and elevated temperatures in the epilimnion.

The transition zone is characterized as that area from Buckboard Marina to the Utah/Wyoming stateline. This zone includes water depths from 10 to 50 meters. In this area turbidity from river inflow is significantly decreased, but blue-green algae blooms still occur. This area of the reservoir has relatively high production, but usually more desirable phytoplankton species with higher diversity occur. The cold water fish habitat is generally good throughout the year, as adequate dissolved oxygen is maintained.

The lacustrine zone of the reservoir is characterized as the area from the stateline to the dam. This zone is extremely clear, deep and often cold water. Primary production is usually low except in local embayments.

Flaming Gorge has a distinct temperature stratification which begins in late May and is strongly stratified in early September. The thermocline as reported begins to form at 9 meters and moves deeper to 21 meters in late summer. The fall turnover usually occurs in mid November and produces a largely isothermic situation (CH_2M Hill, 1977). Dissolved oxygen declines below the thermocline to below 2.0 mg/L in late July and continues to degrade through September to anoxic conditions.

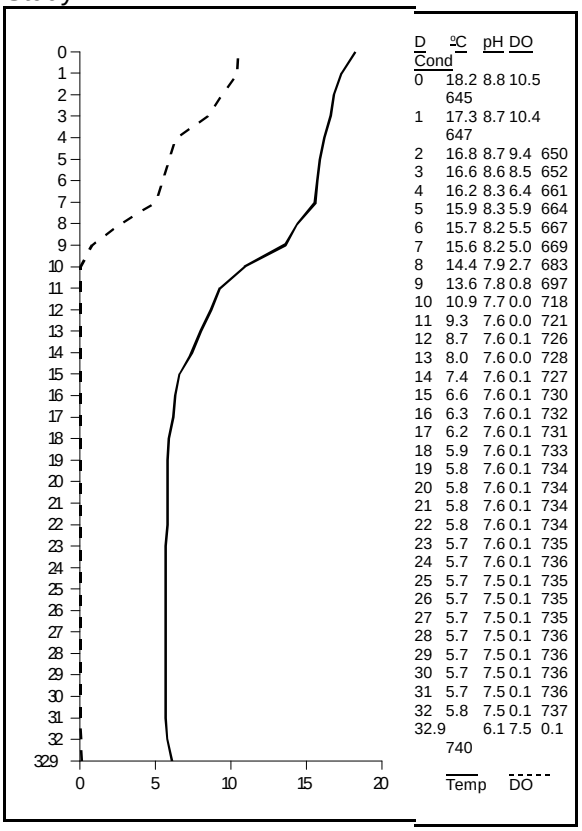
Additional data is needed to further characterize the water quality of the reservoir. Currently a program between the Division of Water Quality and the U.S. Forest Service is being developed to assist in the gathering of data to understand the limnology of the reservoir and determine any existing water quality trends that may be developing in the reservoir. Most of the data reported

Limnological Data

Surface Data	1975
Trophic Status	M
Chlorophyll TSI	47.50
Secchi Depth TSI	42.37
Phosphorous TSI	48.05
Average TSI	45.97
Chlorophyll a (ug/L)	5.6
Transparency (m)	3.4
Total Phosphorous (mg/L)	-
pH	8.5
Total Susp. Solids (mg/L)	-
Total Volatile Solids (mg/L)	-
Total Residual Solids (mg/L)	-
Temperature (°C / °f)	13/55
Conductivity (umhos.cm)	532
Water Column Data	
Ammonia (mg/L)	0.03
Nitrate/Nitrite (mg/L)	0.53
Hardness (mg/L)	-
Alkalinity (mg/L)	156
Silica (mg/L)	-
Total Phosphorus (ug/L)	21
Miscellaneous Data	
Limiting Nutrient	P
DO (Mg/l) at 75% depth	6.4
Stratification (m)	15-17
Depth at Deepest Site (m)	125

Data (1975) was summarized from 1975 EPA eutrophication study with the exception of the profile information (April/Oct 1972 by CH_2M Hill).

here is reflective of the 1975 National Eutrophication Study.



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Recent stocking reports indicate that DWR stocks the reservoir with 200,000 to 500,000 subcatchable rainbow trout (*Oncorhynchus mykiss*). In addition the reservoir contains populations of kokanee (*Oncorhynchus nerka*), lake trout (*Salvelinus namaycush*), smallmouth bass (Micropterus dolomieui), largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*), brown trout (*Salmo trutta*, whitefish (*Prosopium spilonotus*), Utah chub (*Gila atraria*) brook trout (*Salvelinus fontinalis*) and cutthroat trout (Salmo clarki). According to DWR personnel during the period 1981-88 the reservoir was stocked with rainbow (7,652,286), cutthroat (128,100) and brown trout (1,417,613), kokanee (229,900), smallmouth bass (10,000) and channel catfish (311,294).

The reservoir has not been chemically treated by the DWR, but there are probably limited populations of native fishes present in the reservoir because of temperature problems. The Green River is naturally warm and muddy. Impoundment of the water allows silt to settle to the floor of the reservoir, and only surface water is heated by the sun. This results in cold clear water, which is good for trout, but so different from the original river that the native fish have become regionally extinct. In fact, the reservoir has turned the river below it into a cold, clear trout stream, which has further eliminated natural habitat. Recovery plans for the endangered fishes (Colorado Squawfish, Razorback Sucker, Humpback Chub, Roundtail chub and the Bonytail chub) include releasing only warm water from the surface of the
reservoir, and releasing large amounts of water in the spring to restore the natural flow regime of the Green River. This program was completed for the spring of 1993, and resulted in the desired surge of warmer water, mimicking the natural cycle.

Phytoplankton in the euphotic zone include the following taxa (in order of dominance) as summarized in the 1975 EPA National Eutrophication Survey:

Date	Species	Algal Units per ml
05/15/75	*Stephanodiscus sp.*	1,981
	Fragilaria sp.	775
	Diatoma sp.	258
	Chroomonas sp.	258
	Navicula sp.	43
08/07/75	*Chroomonas sp.*	1,331
	Aphanizomenon sp.	951
	Fragilaria sp.	428
	Cryptomonas sp.	333
	Melosira sp.	190
	Other genera	428
09/22/75	*Aphanizomenon sp.*	1,086
	Cryptomonas sp.	827
	Chroomonas sp.	465
	Oscillatoria sp.	103

Information

Management Agencies	
Uinta Basin Association of Governments	722-4518
Division of Wildlife Resources	538-4700
Division of Water Quality	538-6146
Ashley National Forest	784-3445
Recreation	
Flaming Gorge National Recreation Area	784-3445
Dinosaurland Travel Region (Vernal)	789-6932
concessionaire?	
Flaming Gorge KOA (Manilla)	784-3184
Reservoir Administrators	
Department of the Interior	524-5403

Pollution Assessment

Nonpoint pollution sources include nearly all possible sources, including grazing, logging, mining, heavy industry, irrigated agriculture, urban areas, recreation, summer homes, land development, and others. Most critical to the water quality in the Utah portion of the reservoir are logging, mineral exploration, and recreation.

At the time of this writing (summer 1993), the Wasatch-Cache and Ashley National Forests are proposing to open the entire north slope of the Uintas to logging and oil drilling. This would put the Flaming Gorge Reservoir at some risk, but most areas of the Uintas have long stream distances to mitigate impacts, and exploitation would be carefully mitigated to avoid adverse environmental affects, so impact should be minimal. Watershed damage in streams that flow directly into the reservoir (Spruce Creek, Cart Creek, Skull Creek, Eagle Creek, Cub Creek, Carter Creek, Death Creek and Sheep Creek) would have significant impacts on reservoir water quality because these streams are not long enough to significantly mitigate impacts.

The north slopes of the Uintas are very heavily logged, with many clear-cuts taking place every year. Recovery of the coniferous forest is slow in many places and nonexistent in others, despite planting. While little erosion is apparent, if large areas remain barren it is expected that increased erosion will occur.

There are no active mines in the Utah portion of the watershed, but old sites that have not been reclaimed can leach heavy metals and sediments into waterways.

Cattle graze up to the shoreline of the reservoir. In much of the Utah portion, the shoreline area is too rugged for the animals to reach the shore, and so rocky that they do little damage. The Wyoming portion, however, is more characteristic of desert reservoirs, and cattle have significant adverse riparian impacts.

Agricultural areas in Wyoming include Bridger Valley, Bear Valley, Eden Valley, and Star Valley.

Utah point sources of pollution include the Manila Waste water Lagoons and the Flaming Gorge Waste water Treatment Plant. The Manila lagoons have been expanded and currently do not discharge. In Wyoming, Rock Springs and Green River both have sewage Treatment Plants, and there are mining and oil drilling operations throughout the watershed..

Beneficial Use Classification

The state beneficial use classifications include: culinary water (1C), recreational bathing (swimming) (2A), boating and similar recreation (excluding swimming) (2B), cold water game fish and organisms in their food chain (3A) and agricultural uses (4).